What we claim as our invention is:

1. Two-stage optical regenerator for regenerating a data signal comprising a series of optical pulses and having a predetermined bit period, the regenerator having first and second stages each comprising:
   (i) a modulator for modulating a reference signal with an input signal; and
   (ii) an interferometer for causing the modulated reference signal to interfere with another version of the modulated reference signal delayed by less than one bit period of the data signal to regenerate the input signal;
   in which the input signal of the modulator of the first stage of the regenerator comprises the data signal, and the input signal of the modulator of the second stage of the regenerator comprises the output from the first stage of the regenerator,
   wherein relative phase offsets are induced at the outputs of the two interferometers of the regenerator to obtain a condition selected from:
   a. minimum transmission from each of the interferometers by the maximum power levels of the respective input signals transmitted therethrough; and
   b. maximum transmission from the interferometer of the first stage by the maximum power level of the data signal, and minimum transmission from the interferometer of the second stage by the minimum power level of the output from the first stage of the regenerator.

2. Optical regenerator according to claim 1, wherein the said first stage of the regenerator comprises a semiconductor optical amplifier coupled to a Mach-Zehnder interferometer having a relative delay of less than one bit period of the data signal between its arms, the data signal at a first wavelength within the gain band of the semiconductor optical amplifier, and said reference signal comprising a continuous wave at a second wavelength, also within the gain band of the semiconductor optical amplifier, being coupled to the semiconductor optical amplifier.

3. Optical regenerator according to claim 1, wherein said first stage of the regenerator comprises a Mach-Zehnder interferometer having a first semiconductor optical amplifier in one arm, and a second semiconductor optical amplifier in the other arm, the data signal at a first wavelength within the gain band of the semiconductor optical amplifiers being coupled to the first semiconductor optical amplifier and through a delay of less than one bit period of the data signal to the second semiconductor optical amplifier, and the reference signal comprising a continuous wave or clock stream at a second wavelength, also within the gain band of the semiconductor optical amplifiers, being coupled to both arms of the interferometer.

4. Optical regenerator according to claim 1, wherein said first stage of the regenerator comprises a semiconductor optical amplifier coupled in series to a polarisation-dispersive element providing a relative delay of less than one bit period of the data signal between its fast and slow axes, a polarisation controller and a polariser, the data signal at a first wavelength within the gain band of the semiconductor optical amplifier and the reference signal comprising a continuous wave at a second wavelength, also within the gain band of the semiconductor optical amplifier, being coupled to the semiconductor optical amplifier.

5. Optical regenerator according to claim 2, wherein the data signal propagates in the same direction as the reference signal through the semiconductor optical amplifier(s).

6. Optical regenerator according to claim 5, further comprising a band-pass filter to block transmission of the data signal at the first wavelength out of the regenerator.

7. Optical regenerator according to claim 2, wherein the data signal propagates in the opposite direction to the reference signal through the semiconductor optical amplifier(s).

8. Optical regenerator according to claim 2, wherein said second stage of the regenerator comprises a semiconductor optical amplifier coupled to a Mach-Zehnder interferometer having a relative delay of less than one bit period of the data signal between its arms, the regenerated data signal from the first stage of the regenerator at the second wavelength lying within the gain band of the semiconductor optical amplifier of the second stage, and a reference signal comprising a continuous wave at a third wavelength, also within the gain band of the semiconductor optical amplifier of the second stage, being coupled to the semiconductor optical amplifier of the second stage.

9. Optical regenerator according to claim 2, wherein said second stage of the regenerator comprises a Mach-Zehnder interferometer having a first semiconductor optical amplifier in one arm, and a second semiconductor optical amplifier in the other arm, the regenerated data signal from the first stage of the regenerator at the second wavelength lying within the gain band of the semiconductor optical amplifiers of the second stage being coupled to the first semiconductor optical amplifier of the second stage and through a delay of less than one bit period of the data signal to the second semiconductor optical amplifier of the second stage, and a reference signal comprising a continuous wave or clock stream at a third wavelength, also within the gain band of the semiconductor optical amplifiers of the second stage, being coupled to both arms of the interferometer of the second stage.

10. Optical regenerator according to claim 2, wherein said second stage of the regenerator comprises a semiconductor optical amplifier coupled in series to a polarisation-dispersive element providing a relative delay of less than one bit period of the data signal between its fast and slow axes, a polarisation controller and a polariser, the regenerated data signal from the first stage of the regenerator at the second wavelength within the gain band of the semiconductor optical amplifier of the second stage and a reference signal comprising a continuous wave at a third wavelength, also within the gain band of the semiconductor optical amplifier of the second stage, being coupled to the semiconductor optical amplifier of the second stage.

11. Optical regenerator according to claim 8, wherein the regenerated data signal from the first stage of the regenerator propagates in the same direction as the reference signal through the semiconductor optical amplifier(s).

12. Optical regenerator according to claim 11, further comprising a band-pass filter to block transmission of the regenerated data signal from the first stage of the regenerator at the third wavelength out of the regenerator.

13. Optical regenerator according to claims 8, wherein the regenerated data signal from the first stage of the regenerator propagates in the opposite direction to the reference signal through the semiconductor optical amplifier(s).

14. Optical regenerator according to claim 8, wherein the third wavelength is the same as the first wavelength.

15. Method of regenerating a data signal comprising a series of optical pulses, the method comprising two stages, each stage comprising the steps of:

(i) modulating a reference signal with an input signal; and

(ii) causing the modulated reference signal to interfere with a version of the modulated reference signal delayed by less than one bit period of the data signal to regenerate the input signal;

in which the input signal of the first stage comprises the data signal, and the input signal of the second stage comprises the output from the first stage, wherein relative phase offsets between the modulated reference signals and delayed versions thereof are adjusted to obtain a condition selected from those in which:

a) the outputs from both stages are at minimum power levels when the respective input signals are at maximum power levels; and

b) the output from the first stage is at a maximum power level when the data signal is at a maximum power level, and the output from the second stage is at a minimum power level when the output from the first stage is at a minimum power level.